ASSOCIATION OF RHABDOCLINE NEEDLE BLIGHT AND EPICORMIC BRANCHING IN DOUGLAS-FIR

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ABSTRACT.— In northern Utah, Douglas-firs (*Pseudotsuga menziesii* [Mirb.] Franco) with symptoms of *Rhabdocline* needle blight had a significantly higher frequency of epicormic branching than did healthy trees. It is not known whether *Rhabdocline* infection stimulates epicormy, or whether the proliferation of epicormics increases resistance to the disease.

Rhabdocline needle blight is a leaf disease of Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) caused by the ascomycete *Rhabdocline pseudotsugae* Syd. (Hepting 1971). Infection sometimes results in defoliation serious enough to cause death, even in relatively vigorous trees up to 100 years old (Davidson and Prentice 1967).

Douglas-fir, especially in the Rocky Mountains, is subject to the formation of epicormic branches that arise from dormant buds borne at the base of primary branches. The occurrence of epicormics appears to be a normal consequence of branch decline not requiring pest attack for its expression (Bryan and Lanner 1981), but the added stress of *Rhabdocline* defoliation may increase the frequency of epicormics in infected trees. The purpose of the observations reported here was to determine whether trees infected by *Rhabdocline* differ from healthy trees in their frequency of epicormic branches.

METHODS

These observations accompanied a detailed morphological study of epicormics that has been reported elsewhere (Bryan and Lanner 1981). Pole-sized Douglas-firs were selected at intervals along trails in Logan Canyon, Cache National Forest, Utah. *Rhabdocline*-infected trees were identified by the sparseness of their crowns, which had lost many of the needles predating those of the current year (N. Van Alfen, pers. comm.). These trees were found mainly in dense, pure stands on north-facing slopes between 1524 and 1860 m elevation, and often near streams. Uninfected trees in those stands were chosen randomly for comparison. Trees were examined in the summer, when needles infected in the previous year had already fallen (Davidson and Prentice 1967). Epicormic frequency was determined by examining the 10 uppermost dead primary branches below the base of the live crowns, and recording the number of those branches with associated epicormics. The Z-test (Dixon and Massey 1969) was used to test the hypothesis that the mean number of epicormics was equal for healthy and diseased trees. The hypothesis that the frequency distributions were equal was tested with the Kolmogorov-Smirnov two-sample test (Conover 1971).

RESULTS

Trees with *Rhabdocline* symptoms had an average of 4.8 (of 10) branches with epicormics in the lower crown, but similar healthy trees averaged only 3.0 such branches (Table 1). The Z-value of 2.23 was significant at the 99 percent level. The frequency distribution of trees with n number of epicormics also differed significantly ($\alpha = .05$) between healthy and diseased trees (Table 2).

DISCUSSION

It is apparent that *Rhabdocline*-infected trees exhibit a higher frequency of epicormics than do healthy trees. Our data do not indicate whether this is because repeated or periodic defoliations stimulate epicormic

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formation, or whether trees that are *Rhabdocline*-susceptible also happen to be prone to epicormics. A third possibility is that susceptible trees are more likely to survive *Rhabdocline* if they balance their losses of photosynthetic surface area with new foliage borne on epicormic branches. If this is the case, *Rhabdocline*-infected trees incapable of producing numerous epicormics may have evaded our sample by suffering higher mortality. Douglas-firs in Logan Canyon, as elsewhere, show marked individual variability in their production of epicormics (Bryan and Lanner 1981).

Johnson and Denton (1975) have credited epicormics with promoting the survival of Douglas-firs partially defoliated by the spruce budworm. The survival of trees infected by *Rhabdocline* might also be promoted by epicormics. Rhabdocline-infected trees may repeatedly cast off all their one-year-old foliage the year following infection, thus suffering a heavy loss of photosynthetic surface. Epicormics stimulated by the increased solar radiation permitted by such defoliation may serve as an important source of needed photosynthate. If the sprouting of epicormics indeed enables Douglas-fir to recover from *Rhabdocline* and extend its reproductive life, we would expect natural selection to result in a higher frequency of that trait where *Rhabdocline* is of high frequency. According to Hepting (1971), Rocky Mountain Douglas-fir (var. *glauca*) is extremely susceptible to *Rhabdocline* but the Pacific coast variety (var. *menziesii*) is relatively resistant. Our studies (Bryan and Lanner 1981) show that in the eastern part of the intermountain area nearly all the Douglas-firs produce epicormics, but in the western part of this region epicormic production is extremely variable and is even exceeded by epicormic frequency in coast Douglas-fir. Thus, central Idaho plots had considerably fewer trees with epicormics than the average of several California plots, and the range was also far lower. Therefore, unless it is demonstrated that *Rhabdocline* is a more serious pest of Douglas-fir in the eastern intermountain region than in Idaho, our results do not support the hypothesis that *Rhabdocline* has been a significant factor, at least at the regional level, in selection for epicormic branching. Further study of the role of epicormics in Douglas-fir survival and longevity seems warranted, whether or not it bears a relationship to *Rhabdocline* resistance.

TABLE 1. Number of branches with epicormics on Douglas-fir trees in Logan Canyon, Utah, in relation to *Rhabdocline* infection.[1]

Rhabdocline condition	Number of branches of 10		
	Mean	Range	S.D.
Healthy trees (n = 73)	3.0a	0–10	2.5
Infected trees (n = 20)	4.8a	0–8	2.9

[1]Values followed by the same letter differ significantly at 0.01 level.

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TABLE 2. Frequency distribution of epicormic branches on healthy and *Rhabdocline*-infected trees.[1]

Number of lateral branches with associated epicormics	Healthy trees	Diseased trees
	Percent of total	
0	15.1	4.3
1	17.8	17.4
2	15.0	8.7
3	16.5	8.7
4	12.3	8.7
5	12.3	8.7
6	1.4	13.1
7	0	17.4
8	2.7	13.0
9	5.4	0
10	1.4	0

[1]Based on observations of 10 branches per tree on 73 healthy trees and 20 *Rhabdocline*-infected trees.